Editorial

Quantitative index calculated by ^{99m}Tc-GSA scintigraphy

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Abstract: ^{99m}Tc-galactosyl human serum albumin (GSA) scintigraphy is useful to evaluate hepatic function and hepatic functional reserve. A reliable SPECT and CT integrated system is now commercially available. Using this system, we can obtain ^{99m}Tc-GSA SPECT/CT fused imaging with a small registration error. Therefore, the ^{99m}Tc-GSA scintigraphy techniques prove more useful in clinical practice than have been previously reported. In the latest Annals of Surgical Oncology on Oct 2014, the uptake index (UI) values calculated from ^{99m}Tc-GSA scintigraphy are reported to be useful for predicting the functional reserve of the future remnant liver. In this paper, we describe the usefulness of ^{99m}Tc-GSA scintigraphy as well as some cautions that are necessary as regards using the system.

Keywords: ^{99m}Tc-GSA scintigraphy; SPECT/CT; uptake index (UI)

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^{99m}Tc-labeled diethylenetriamine penta-acetic acid galactosyl human serum albumin (GSA) is an analogue ligand that binds to asialoglycoprotein receptors on the hepatocyte cell membranes (1). Therefore, ^{99m}Tc-GSA scintigraphy is reported to be useful to evaluate function and functional reserve of the liver. There are various models and methods for assessing hepatic function when using ^{99m}Tc-GSA scintigraphy. Recently, the uptake index (UI) and UI values calculated from ^{99m}Tc-GSA scintigraphy were reported as a novel index in the *Annals of Surgical Oncology* on Oct 2014 (2,3). UI values were described as being useful to evaluate the liver function. UI values are obtained by combining UI and ^{99m}Tc-GSA SPECT and contrast enhanced CT (CE-CT) fused imaging. UI values can correctly reflect the regional function of the liver because of the additional information provided by the CT imaging. Receiver operating characteristic curve analysis demonstrate that the UI values have almost perfect diagnostic performance for predicting the risk of liver failure (area under curve is 0.95). In a previous study, R max calculated from ^{99m}Tc-GSA scintigraphy is also reported to be useful to predict the postoperative liver failure (4). Both of these indices display almost a perfect diagnostic performance for postoperative liver failure. Although the calculating method for R_{max} is highly complex, the UI is based on a simple 2-compartment model.

The UI values are reported to be useful to evaluate not only the regional function but also postoperative hepatic function. The correlation coefficient between the predicted UI and actual postoperative UI is 0.95. Moreover, there is a correlation between the predicted UI and laboratory and clinical variables such as the presence of ascites, total bilirubin, and prothrombin time. Therefore, we suggested that UI values reflect not only preoperative hepatic function but also hepatic functional reserve of the future remnant liver, and UI values are an ideal index for hepatectomy planning.

For accurate assessment of the hepatic function by using ^{99m}Tc-GSA scintigraphy, the quality of the scintigraphic images is essential to maintain the quantitative nature of the indexes. There are various indices including UI calculated from ^{99m}Tc-GSA scintigraphy that are reported to be useful to evaluate function and functional reserve of the whole liver and regional liver. However, the methods for obtaining the scintigraphic images and the reconstruction methods of scintigraphic images are not the same. Therefore, it is necessary to know the strong and weak points associated with the images for accurate and adequate use.

The receptor index (LHL15) and clearance index (HH15) are the most commonly used parameters and are reported to be useful for assessing the function and functional reserve of the liver. Although both indices are very simple and convenient, from our own experience, we suggest there are some cautions that are warranted in relation to using both indices. The first, the anatomical information is not sufficient to adequately evaluate the function of the future remnant liver. Also, to evaluate the regional function these indices have to be corresponded with the CT volumetry. The second, it is not possible to correct the attenuation. Attenuation is the most important factor affecting the quantitative imaging (5). The third, the tumor location sometimes resulted in underestimating the whole liver function. Because the dynamic scintigrams are obtained by a frontal gamma camera, when a big tumor is located on the anterior section or lateral section of liver, the counts for the whole liver are sometimes underestimated. The UI and UI values are also obtained by dynamic scintigrams. UI and UI values warrant the same cautions as those for HH15 and LHL15. Therefore, for the proper use of UI, we have to understand these cautions.

A SPECT and CT integrated system is now commercially available. This SPECT/CT integrated system allows us to obtain SPECT/CT fused images with an excellent registration. The excellent registration of SPECT/CT fused imaging is a very important factor. First of all, we can perform CT based attenuation correction on the reconstructed SPECT image. The liver is not round and the area around the liver is quite complex. Therefore, CT based attenuation correction is better than Chang's methods and it results in preserving the good quantitative nature of the indices. Secondly, we can add the anatomical information to the SPECT image. Although the SPECT image contains 3D information, this is not sufficient to evaluate the regional function corresponding with the surgical procedure. Moreover, the latest SPECT/CT integrated systems have multi-detector row CT. In our hospital, the SPECT/CT system has 16 row-CT. Using this system, we can make fused imaging of the SPECT image and dynamic CE-CT image. In this way, we can evaluate the function of regional liver based on the portal and hepatic vein tributaries (6). UI values are calculated by a combination of UI and ^{99m}Tc-GSA SPECT/CT fused images. However, it was not clarified what kind of machines and methods were used to obtain ^{99m}Tc-GSA SPECT image and CT image. So it is difficult to understand how to reduce the registration error of ^{99m}Tc-GSA SPECT/CT fused images.

Moreover, we should know that there are other cautions needed due to the pharmacokinetics of GSA. GSA binds to asialoglycoprotein receptors on the hepatocyte cell membranes and is excreted into the bile. Usually the excretion started in about 40 minutes after the administration of GSA. Therefore, SPECT scanning should be finished at least within 40 minutes to obtain accurate information of the functional distribution of the liver. We perform dynamic scintigrams and SPECT scanning in one test and obtain the SPECT images within 35 minutes. Although UI values were obtained by the combination of UI and ^{99m}Tc-GSA SPECT/CT fused images, the SPECT parameter was not fully explained. Therefore, we question the quantitative accuracy of the UI values due to the scant information provided about image acquisition and reconstruction.

Conclusions

In this report, we suggested that the indices calculated from ^{99m}Tc-GSA scintigraphy are useful for safe hepatectomy. Especially, the UI values are ideal for hepatectomy planning. On the other hand, for the accurate assessment of regional hepatic function we have clarified the strong and weak points of ^{99m}Tc-GSA scintigraphy and the pharmacokinetics of GSA.

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